The work from BLACKMAN'S laboratory has done much to substitute a physico-chemical conception for the too general stimulus conception of the German plant physiologists. In this direction these papers again bring forth evidence for the non-existence of true optima, for the great importance of "limiting factors," and for the significance of what BLACKMAN has designated as the "time factor."—WILLIAM CROCKER.

Cytology of the ascus.—The controversy to which the behavior of the ascus nucleus has recently given rise, has led GUILLIERMOND[21] to reinvestigate the subject. Contrary to the results of Miss FRASER[22, 23, 24] and her coworkers, these new observations extend and entirely confirm his previous studies, and convince him that the number of chromosomes remains constant during the three successive mitoses of the ascus nucleus. He discusses the method of formation and the separation of the chromosomes of the first division, and whether there exists a second numerical reduction during the third nuclear division. In all of the species studied (*Humaria rutilans*, *Peziza catinus*, *Pustularia vesiculosa*, *Galactinia succosa*), he finds that the number of chromosomes of the equatorial plate stage and of the anaphases remains the same, and that the distribution of these chromosomes is accomplished in the same way in all of these forms. As in previous studies, GUILLIERMOND[25, 26] believes that the process described by MAIRE[27, 28] that is, a double longitudinal division of the chromosomes during the anaphases, which results in doubling the number of chromosomes found in the equatorial plate stage, rests on incorrect observations. He also believes that MAIRE'S contention that there exists in the ascus of *Galactinia succosa* protochromosomes, which fuse into four definite chromosomes, is untenable. GUILLIERMOND holds that there are eight definite chromosomes and not four, which are formed directly and not from protochromosomes. These eight chromosomes are divided only during the meta-

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[21] GUILLIERMOND, M. A., Aperçu sur l'évolution nucléaire des ascomycètes et nouvelles observations sur les mitoses des asques. Rev. Gén. Botanique **23**:89–120. 1910.

[22] FRASER, H. C. I., Contributions to the cytology of *Humaria rutilans*. Ann. Botany **22**:35–55. 1908.

[23] FRASER, H. C. I., and WELSFORD, E. J., Further contributions to the cytology of the ascomycetes. Ann. Botany **22**:465–477. 1908.

[24] FRASER, H. C. I., and BROOKS, W. E. ST. J., Further studies on the cytology of the ascus. Ann. Botany **23**:538–549. 1909.

[25] GUILLIERMOND, M. A., Recherches sur la karyokinèse des ascomycètes. Rev. Gén. Botanique **16**:1–65. 1904.

[26] ———, Remarques sur la karykinèse des ascomycètes. Ann. Mycol. **3**:344–361. 1905.

[27] MAIRE, R., Recherches cytologiques sur quelques ascomycètes. Ann. Mycol. **3**:123–154. 1905.

[28] ———, Recherches sur la karyokinèse chez les ascomycètes. Rev. Gén. Botanique **16**:130–143. 1904.

phases, and not again during the anaphases. The exact manner of division of the chromosomes seems to agree with that described by Miss FRASER, but on the basis of certain stages, which he thinks were missed by her, he interprets his results in a different way. He describes a synapsis stage, whose loops correspond to the V-shaped chromosomes, which later appear on the spindle in the equatorial plate. Although he does not very strongly insist on this point, he is inclined to think that the scheme of chromosome reduction described by FARMER and MOORE for higher forms of plants and animals obtains in the ascomycetes. In the first part of the paper an interesting discussion of the state of these questions and other problems relating to the ascomycetes will be found.—J. B. OVERTON.

Anaerobic growth.—LEHMAN[29] has studied anaerobic growth in higher plants, trying to determine whether the view of WIELER or that of NABOKICH is correct. WIELER claims that the higher plants will not grow in total absence of oxygen, but that only a very low oxygen pressure is needed for growth. NABOKICH claims that higher plants will grow in absence of oxygen. He maintains, however, that proper nutritive conditions must be supplied, as in fungi. For this purpose a glucose solution is suitable. This solution certainly increases anaerobic growth in the pea seed, sunflower seedling, and other forms. In a later article, not cited by LEHMAN, NABOKICH[30] describes the course of anaerobic growth in higher plants. Soon after placing the organ in the oxygen-free medium, growth ceases (Vacuumstarre). Somewhat later growth begins, and the rate rises until it equals that of aerobic growth. Still later growth ceases and death of the organ ensues. NABOKICH explains the course of anaerobic growth as follows: oxygen acts as a stimulus to growth, and not merely as an energy releaser, hence with its withdrawal growth ceases; intramolecular respiration later produces poisonous by-products, which in low concentrations act as stimuli to growth, but which with further accumulations stop growth and kill the organ. The bad feature of this explanation is the indefiniteness of the term stimulus. NABOKICH finds that resting plant cells or those with low metabolic activity can remain in oxygen-free condition for long periods without injury.

LEHMAN found only very slight if any anaerobic growth in *Vicia Faba*, *Pisum sativum*, *Lupinus albus*, *Brassica Napus*, *Phaseolus multiflorus*, and *Cucurbita*, either in distilled water or glucose solution. In *Zea Mays* and *Glyceria fluitans*, anaerobic growth was marked in glucose solution, but was nil in distilled water. In *Helianthus annuus*, anaerobic growth was slight in distilled water, but considerable in glucose solution. LEHMAN concludes that anaerobic growth in any higher plants is not long-enduring nor considerable

[29] LEHMAN, ERNST, Zur Kenntnis des anaeroben Wachstums höheren Pflanzen. Jahrb. Wiss. Bot. **49**:61–90. 1911.

[30] NABOKICH, A. J., Ueber die Wachstumsreize. Beih. Bot. Centralbl. **26**:7–149. 1910.